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# USAAVSCOM TECHNICAL REPORT 70-9 UH-IB/D ARMORED HELICOPTER SEAT TEST PROGRAM

BY

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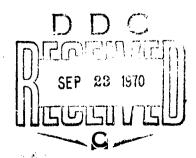
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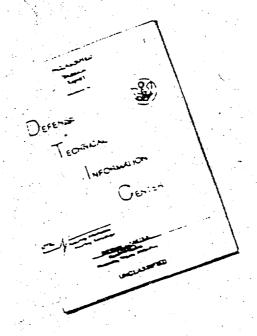
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#### UHAD/UHAB/D ARMORED HELICOPTER

SEAT TEST PROGRAM

CONFUCTED FOR ADROJET, GENERAL CORPORATION

UNDER U. S. ARMY

CONTRACT DA 23 . 204. AMC - 03825(T)

AVSER REFORT NO. M66-7

2 February 1966

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### UH-1B/D ARMORED SEAT TEST PROGRAM VERTICAL DROP TEST SERIES NUMBER THREE

#### INTRODUCTION

The Aerojet-General Corporation is engaged in the development of an armored exew seat for the Bell UH-1B/D series helicopters. It is required that the armored seat developed in this program protect the seat occupant against impact at least as well as the standard UH-1D crew seat. To show compliance with this requirement, a test program was initiated in May 1965 during which the armored seat and a standard UH-1D crew seat were subjected to controlled vertical impacts. Measurements of the vertical accelerations applied to the seats and their occupants were recorded. Study of the recorded data and high-speed motion pictures provided a basis for comparison of the dynamic response of the seat-occupant systems and the forces transmitted to the seat occupants.

This report presents the cosults of two tests of a rederigned armored crow seat conducted 27 January 1966 by Aviation Safety Engineering and Research (AvSER), a Division of Flight Safety Foundation, Incorporated. The results of this series of tests are compared with the results of the first revies of tests completed 21 May 1965

The results of the first series of tests conducted under this program are presented in AvSER Report M65-24, 4 June 1965. The second test series is reported in AvSER Report M66-1, 18 January 1966.

#### TEST OBJECTIVES

The objectives of this test series were:

- To determine the response of a redesigned armored crew seat under 15G and 5G vertical impact conditions.
- 2. To compare the response of the redesigned armored seat with the response of a standard UH-1D crew seat tested in May 1965 under the same conditions.

#### TEST PROCEDURES

The following procedures were followed to conduct this test series.

- accept the single test article. This modification included the addition of ballast weight to bring the total weight of the drop cage and test articles to 1,680 pounds. This ballast compensated for the weight of the UH-1D seat and dummy installed in the first test covies. Of this weight, the armored seat accounted for approximately 137 pounds, the dummy occupant 186 pounds, and the drop cage and ballast weighed 1,357 pounds.
- Instrumentation transducers were installed on the drop cage,
   on the seat frame, and in the decreey occupant.

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- 3. Two high-speed movie cameras (500 frames per second) were installed, providing a front view and a 45° side view of the seat and dummy during the tests.
- 4. The armored seat and dummy occupant were installed in the drop cage and two drop tests were conducted.

#### TEST CONDITIONS

The test conditions specified by Aerojet General called for vertical impacts at the following acceleration levels:

Test No. 1 - 15G peak deceleration, half sine wave pulse,

0.05 second duration

Test No 2 - 5G peak deceleration, half sine wave pulse.

0.05 second duration.

#### TEST INSTRUMENTATION

#### Transducere

The transducers used in this test series were Stathan Instruments

Model A5 accelerometers. Those are sivalulaged type instruments

which provide a frequency response in excess of 200 cycles per

second. Transducers were installed at the following locations to

measure vertical recoleration:

- A. Drop Cage France
- 2. Armound Stat Frame Right
- 3. Annoped Sent Figure . Left

NOT REPRODUCIBLE

- 4. Armored Seat Occupant Pelvic
- 5. Armored Seat Occupant Head

#### Electronic Data Recording System

The measurements listed above were recorded on a magnetic tape recording system. This system utilizes a constant bandwidth FM/FM multiplex modulation technique in which the analog signal from the transducer is converted by a subcarrier oscillator into a frequency deviation proportional to the input signal amplitude. Seven of these subcarrier oscillator catputs are combined in a mixer amplifier and the resulting composite signal is then recorded on one track of a 14-track tape recorder. In this test series the data obtained from each test was recorded on one track of the tape recorder.

#### Electronic Data Processing System

The data reported on the data recording system was recovered by utilizing a compatible data processing system. In this system a tape playback mashing removes the composite signal from each track of the test tape and processes it through a series of FM discriminators. These discriminators separate the composite signal into various subcarrier frequency deviations. These frequency deviations are then converted to an analog signal which is recorded on an oscillograph platter. The resulting oscillograph record is then available as an analog time history plot of the recorded parameter.

#### NOT REPRODUCIBLE

#### Photo Instrumentation

Photographic instrumentation was provided by two Photosonics 1B
16 mm motion picture cameras operating at approximately 500
frames per second. Timing and correlation was provided to aid
in analyzing the motions of the seat and occupant and correlating
this motion with the accelerations measured during each test.

#### TEST RESULTS

#### General

Examination of the results of these two drop tests indicates that the data from these tests are comparable with the data obtained from the earlier test series. Measurable permanent deformation of the seat structure occurred during the 15G test. This deformation was slight, however, and did not detract from the protection afforded the occupant in this test sexies. In both tests of this series the occupant remained upright and well restrained.

A summary of the data obtained from these tests, along with a summary of the data from the earlier tests is presented in Table I.

Pre- and post-tork photographs of Test No. 1 are presented in Figures 1 through 6. These photographs are considered typical of the complete series. The acceleration-time histories of the data recorded during this test program to presented in Figures 2 through 11.

The acceleration-time histories of the date recorded during the Jamuary 1966 test program is presented in Appendix A. Appendix B contains the accelerometer data recorded during the May 1965 test ceries.

#### Data Analysis - Test No. 1 (15G Acceleration)

The input acceleration pulse (drop cage acceleration) achieved in this test is similar to the input acceleration in the May 1955-15G test, so that a comparison may be made between the results of this test and the earlier one.

Figure 7 presents superimposed curves showing data obtained from the 15G tests of each test series. Measurements of drop cage acceleration, seat acceleration, and occupant pelvic acceleration are included, to provide direct comparison of the results obtained from the three tests.

The armored seat occupant experienced a single accoloration pulse with a peak acceleration of 49G and a mean acceleration of 31G.

Because of the increased rate of onset and the high maximum acceleration, this acceleration environment would likely produce a more severe effect upon a human accupant that the occupant accelerations experienced in citizen of the 15G tests in the first two test series.

(Reference acceleration time convex in Figure 7 and the Appendices.)

This test produced more deformation of the armored seat support structure than was experienced in earlier tests, also, indicating the food, developed in this foot oppose and the structural limits for this test. The most obvious deformation which indicated impending structural failure was forward heading of the right of vertical support take. The seat was raised to its highest position

for this test, and the support tube bent at the location of the highest exposed vertical positioning hole. This bending can be seen in Figure 4. Two cracks appeared in the right (sliding) side armor plate lower support bracket as shown in Figures 5 and 6, and this armor panel came out of the upper slide, but remained in place.

The right forward corner of the seat pan was permanently deflected downward 1-1/16 inches and the left corner was permanently deflected downward. 13/16 inch. The dummy occupant settled downward in the seat enough (approximately 3/4 inch) to allow approximately 1-1/2 inches of slack in the lap belt. This permanent downward deflection is beneficial as an energy absorption mechanism for vortical impacts. The downward settling of the dummy must be controlled, however, so that slack does not develop in the occupant restraint harness which can odd to amplification of ecoupant accolerations is combined vortical and longitudient accoleration environments.

The neverity of the accoloration experienced by the occupant in this test correct to point up the need for high experity energy absorption to provide adequate occupant protection under even moderately reverse impact conditions.

#### Data Analysis - Tost No. 2 [54] Abrolovelyon)

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to the input for earlier tests. Occupant polyic acceleration was less severe in this test then acceleration of the standard UH-ID sear occupant in the earlier test and approximately equivalent to the armored seat occupant accelerations in the earlier tests. The vertical acceleration environment was definitely within tolerable limits.

The next was damaged in the 15G drop test which preceded this test, as mentioned earlier, but maintained enough lead carrying capacity to prevent further deformation in this drop.

#### DISCUSSION OF TEST RECULTS

The armoved evew seat tested in those two drep tests is similar to the seat tested on 11 January 1966 (second test series). The seat pan was changed to provide increased energy obserption.

Analysis of the test results indicates that the protection offered by this seat at low acceleration levels in adequate. At the higher acceleration level, however, this seat did not protect the occupant as well as the seat trated on 11 January 1966 (second test series).

The protection offered by the revised seat was however comparable to that offered by the standard UH-1D crew cent.

15 15 16 17 17 17 17 17 17 17 17 17 17 17 17 17			First Teat Serius (May 1965)	Test Serfes (May 1965)	Second Test Series (January 11, 1966)	est Series 11, 1966:	Third Test Sovies (Jameary 27, 1966	st Series 27, 1966)
Drop Cago   5   11   4   15   5	Test Condition	Accelerometer Location	Mean nG"	Pesk "G"	Meen "G"	Peak "G"	Mean "D"	Feak 1.3"
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Sendard UK-ID Seat (Right)   5   12   12   14   15   14   15   16   14   15   16   14   15   16   14   15   16   14   15   16   16   16   16   17   18   18   19   19   19   19   19   19	Deep Fields 1 Fr.	Standard UH-11 Soat (Loft)	9	22				
Standard Seat Dummy Polyto	Acceptance Andrews	Spandard UH-1D Seet (Right)	មា	12	·		•	
Standard Seat Dummy Food   7   11   5   18   4     Armound Seat (Loft)	000	Standard Soat Dumany Politic	ය	경기			<b>L</b> ends Lend	<b>15.5</b>
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Armoured Seat (Right) 5 11 5 14 4  Armoured Seat Lummy Pelvic 10 21 6 11 6  Armoured Seat Lummy Pelvic 10 18 11 17  Standard UH-1D Seat (Left) 10 24  Standard UH-1D Seat (Right) 12 22 22  Armoured Seat Dummy Felvic 13 27 15 29  Armoured Seat Dummy Felvic 13 28 16 29  Armoured Seat Dummy Felvic 14 30  Armoured Seat Dummy Pelvic 15 22 15 27 14  Armoured Seat Dummy Pelvic 15 35 14 31 31 14  Armoured Seat Clark (Left) 15 22 15 27 14  Armoured Seat Clark (Left) 15 22 15 31 14  Armoured Seat Clark (Left) 15 25 15 31 14  Armoured Seat (Left) 15 22 35 14 31 14  Armoured Seat (Left) 15 25 31 14 31 14  Armoured Seat (Left) 15 25 31 14		Armoned Geat (Loft)	<b>.</b>	<u>u)</u>	w	8	4	**)
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TABLE I. SUMMARY OF ACCELEROMETER DATA

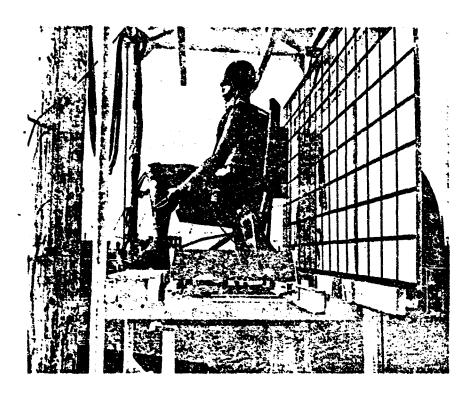


Figure 1. Left Side View of Armored Seat and Occupant, Pre-Test.

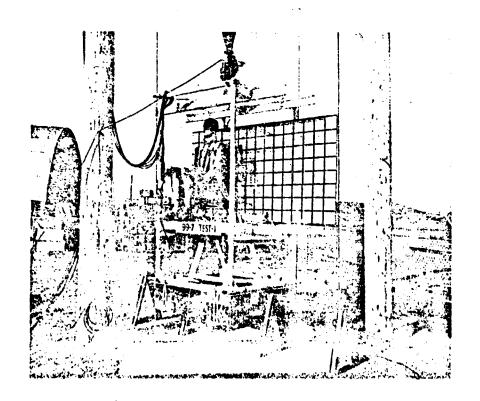


Figure 2. Ordering Left Front View of Armored Sections Ordering Left Fort.

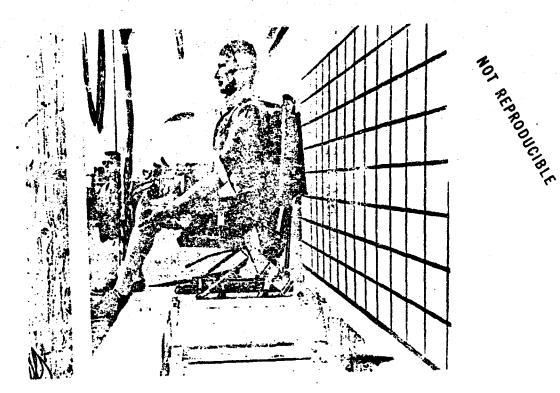


Figure 3. Left Side View of Asmored Seat and Occupent After Test 1.

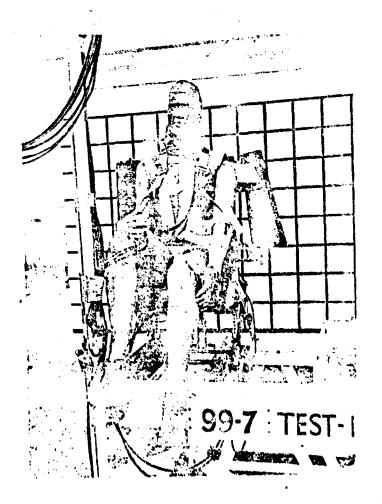


Figure 6. Event Vista of Armored frest and Occupant After Tess 1. (Bent right aft vertical cupport twice shows just below seat pan between lags of dummy.)

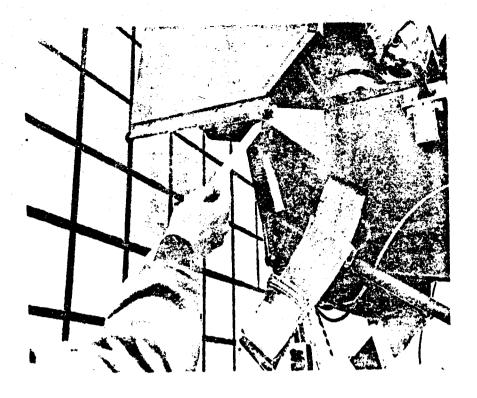
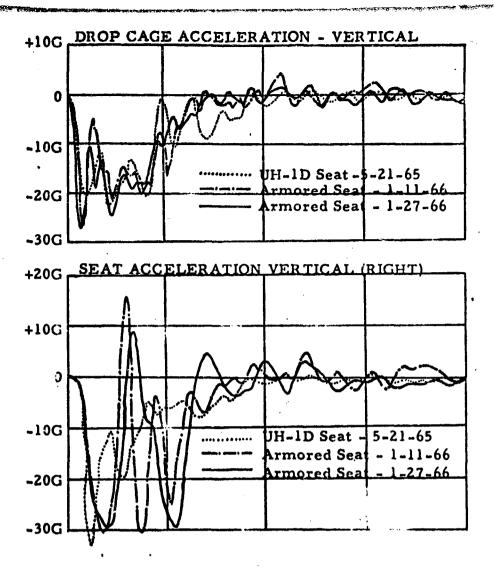


Figure 5. Cracked Sliding Armor Lower Support
Bracket, Following Test 1. (Notice slack
lap belt.)



Figure 6. Econol Cascin in 61 long former Ken in 61 to a Making Total Le



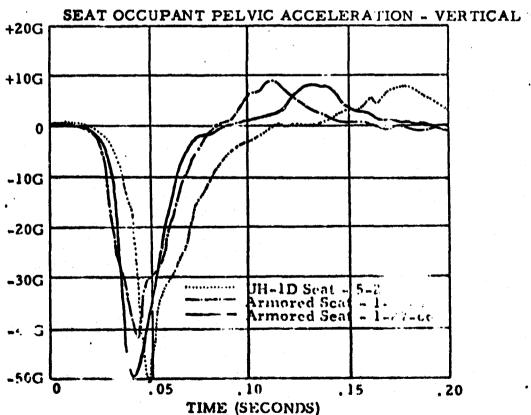
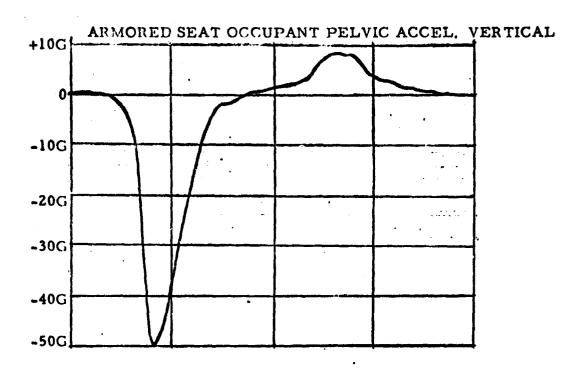


Figure 7. UH-1B/D Armored Seat Test No. 1 With Results of May 1965 and January 11, 1966
Tests Superimposed.



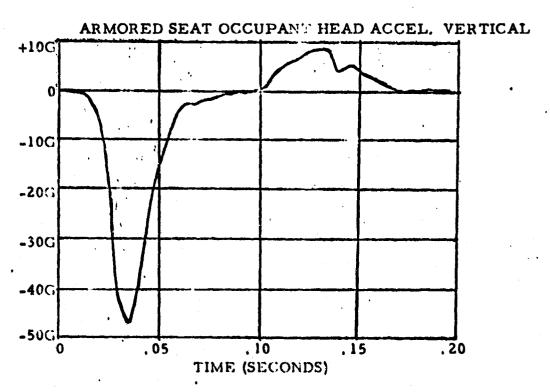
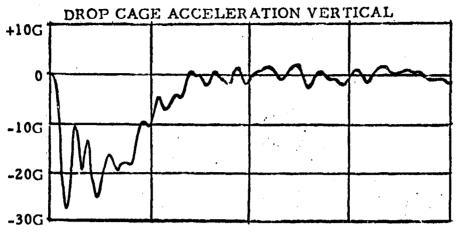
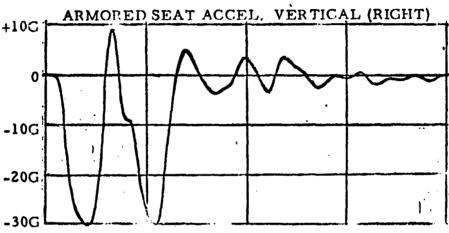


Figure 9. UH-137D ARMORED SEAT TEST NO. 1 THIRD TEST SERIES.





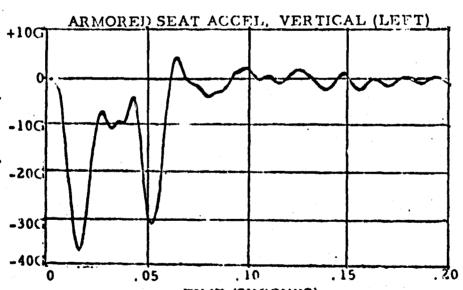
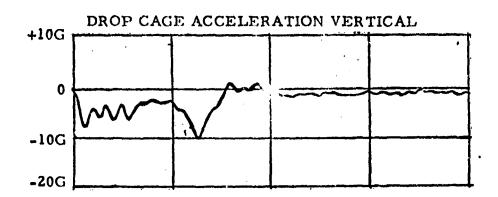
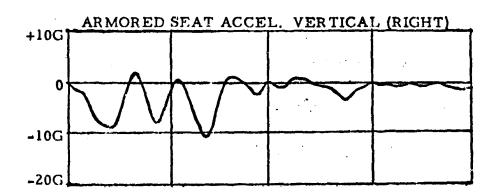


Figure 8. UH-1B/D ARMORED SEAT TEST NO. 1 THIRD TEST SERIUS.





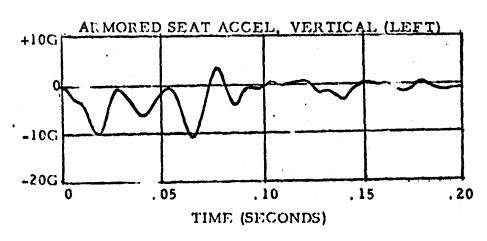
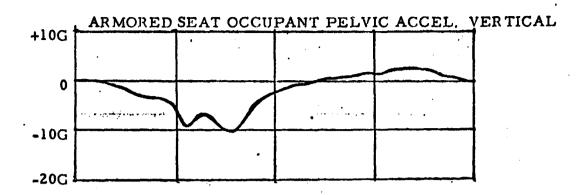


Figure 10. UH-1B/D ARMORED SEAT TEST NO. 2 THIRD TEST SERIES.



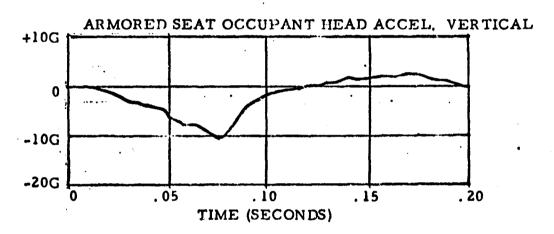
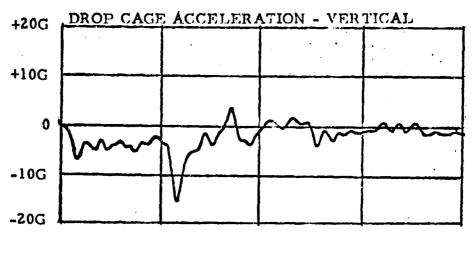
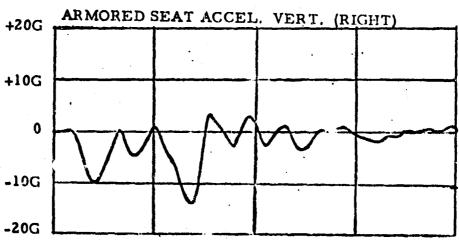


Figure 11. UH-1B/D ARMORED SEAT TEST NO. 2
THIRD TEST SERIES.

## APPENDIX A OSCILLOGRAPH DATA RECORDED DURING SECOND TEST SERIES - JANUARY 1966





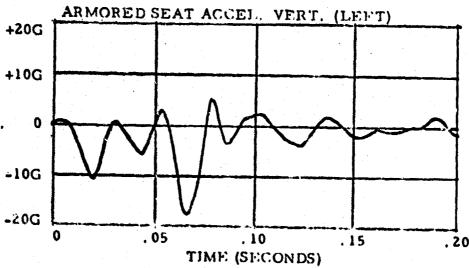
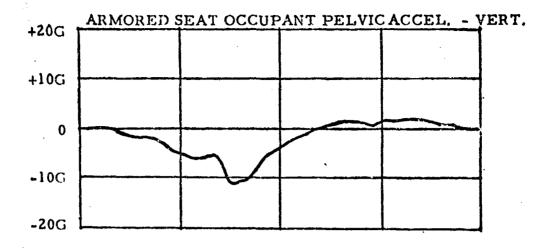


Figure Al. UH-1B/D ARMORED SEAT TEST NO. 1



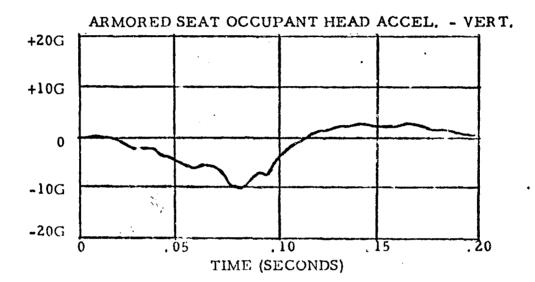


Figure A2. UH-1B/D ARMORED SEAT TEST NO. 1

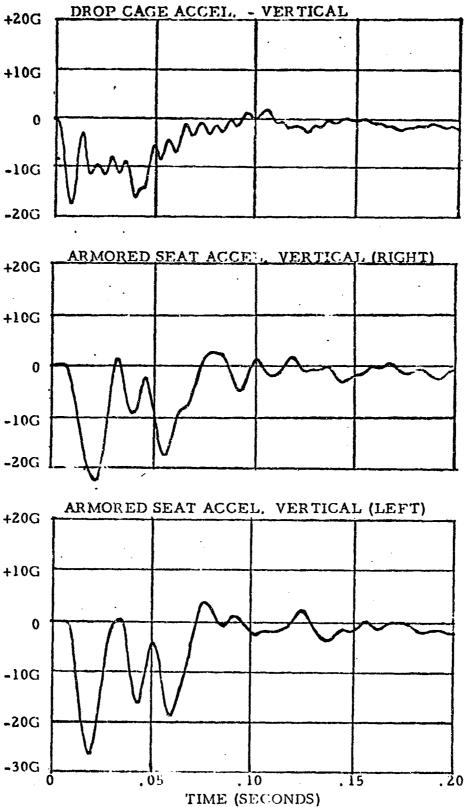
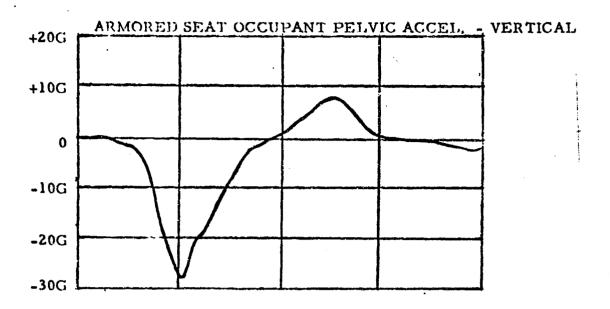


Figure A3. UH-1B/D ARMORED SEAT TEST NO. 2.



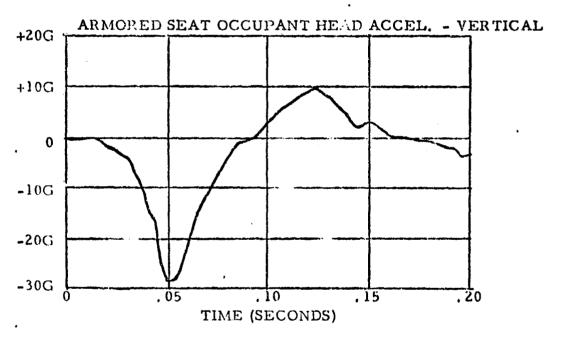


Figure A4. UH-1B/D ARMORED SEAT TEST NO. 2.

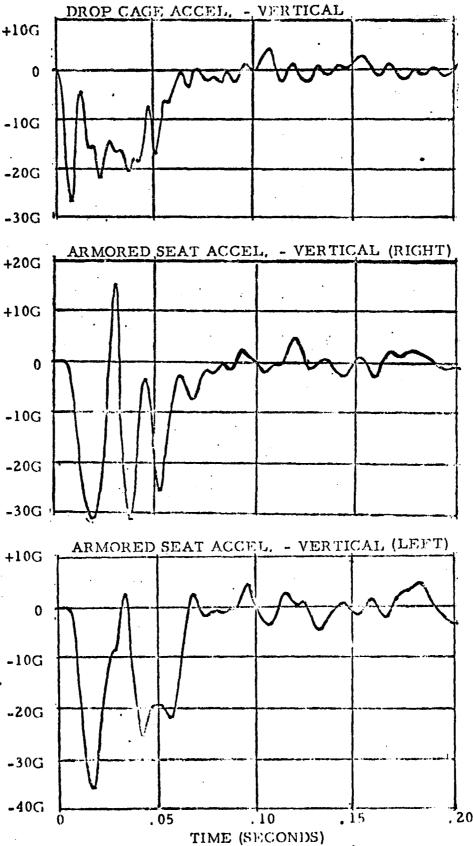
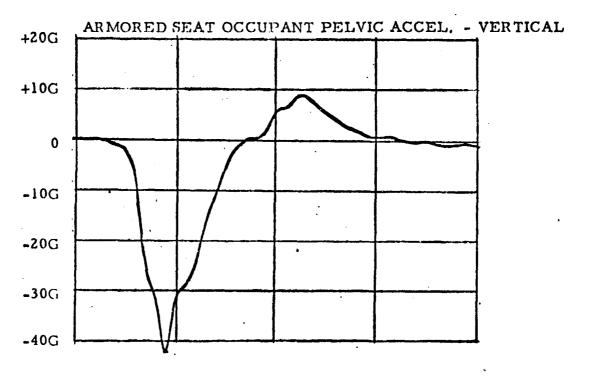


Figure A5. UH-1B/D ARMORED SEAT TEST NO. 3.



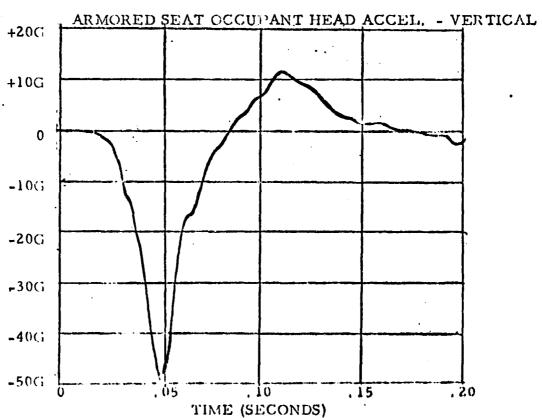


Figure A6. UH-1B/D ARMORED SEAT TEST NO. 3.

## APPENDIX B OSCILLOGRAPH DATA RECORDED DURING FIRST TEST SERIES - MAY 1965

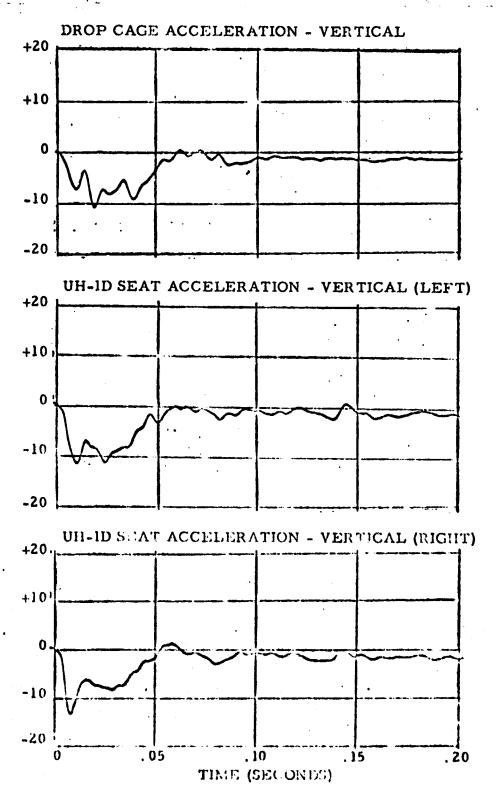


Figure B1. UH-1B/D SEAT TEST NO. 1.

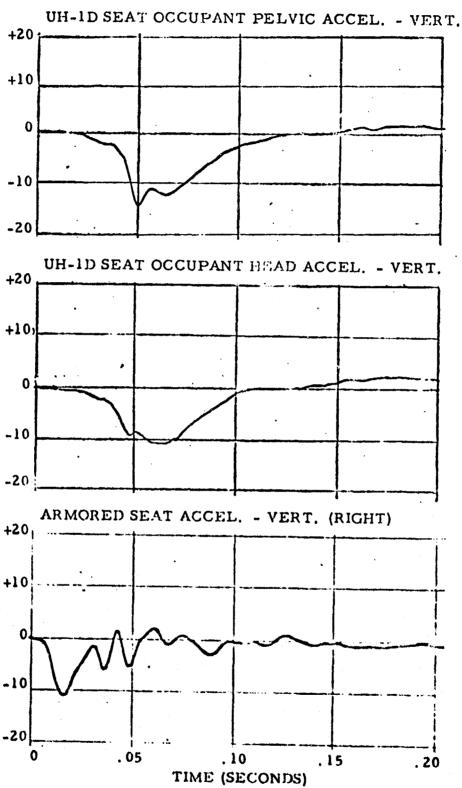
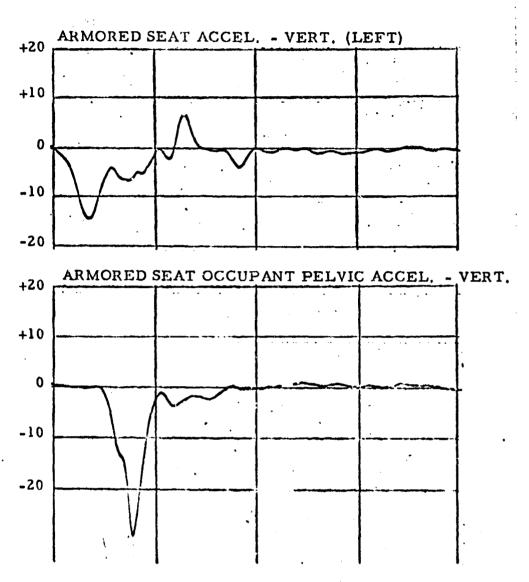


Figure B2. UH-1B/D SEAT TEST NO. 1.



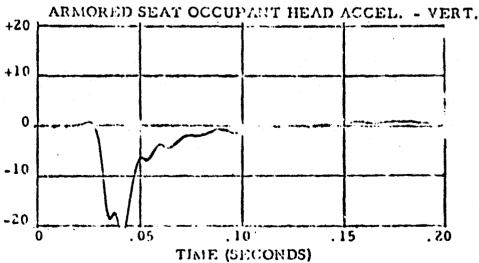
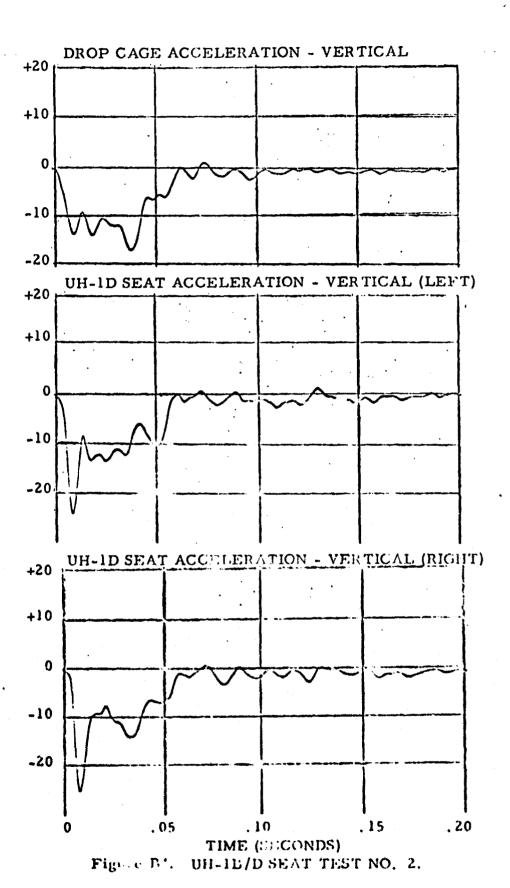
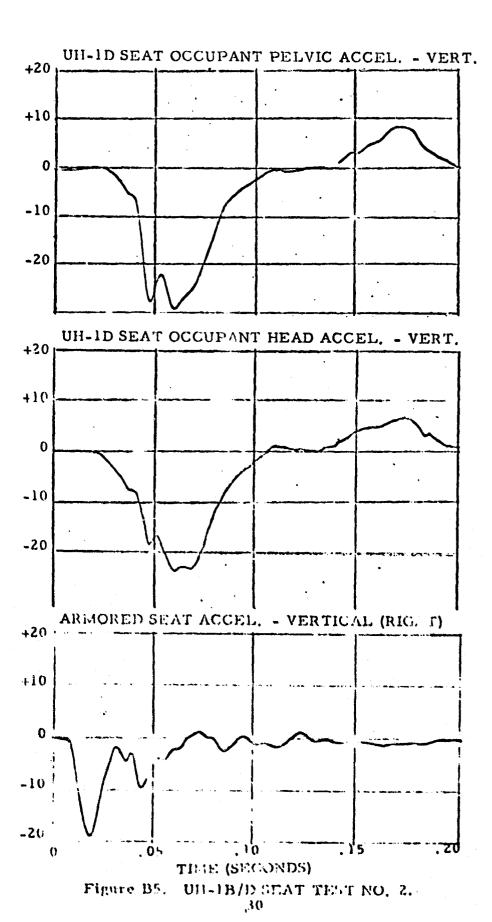
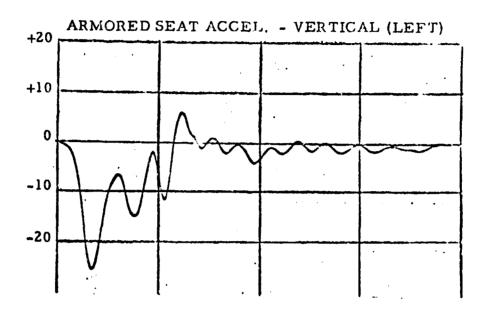


Figure B3.

UII-1E/D SEAT TEST NO. 1.







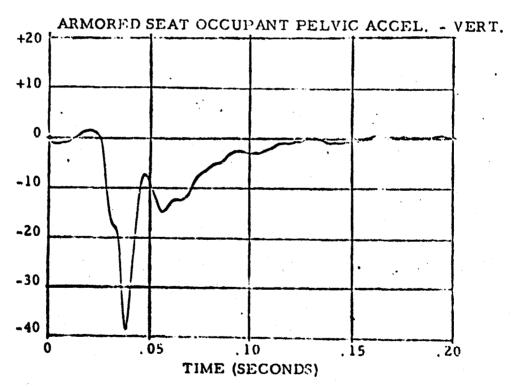


Figure B6, UII-1B/D SEAT TEST NO. 2.

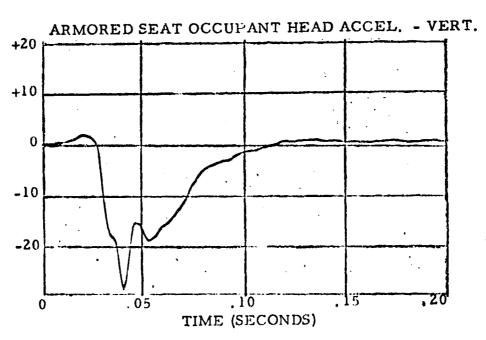
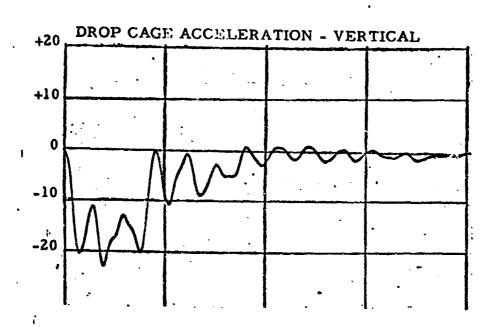


Figure B7. UH-1B/D SEAT TEST NO. 2.



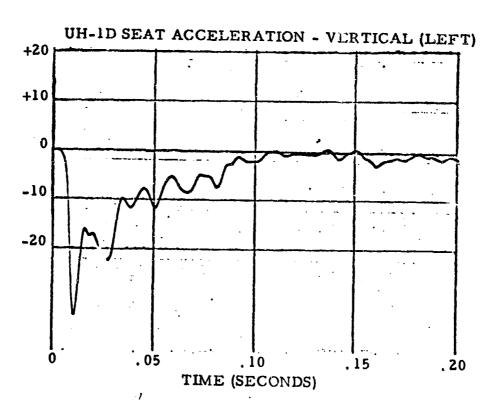
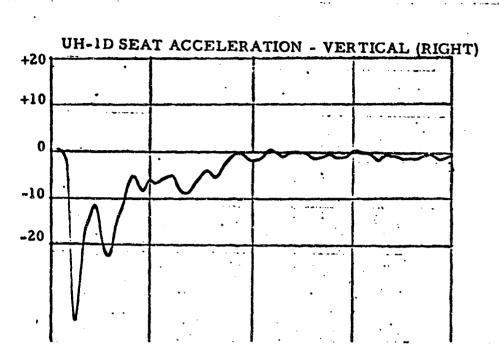
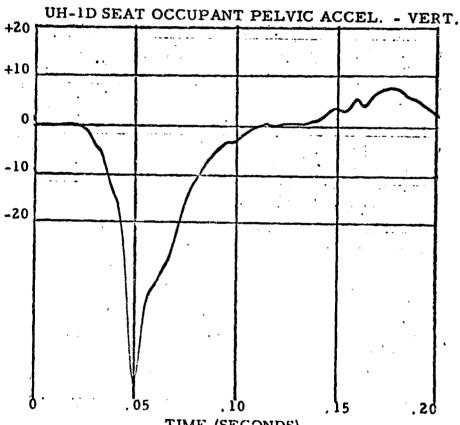
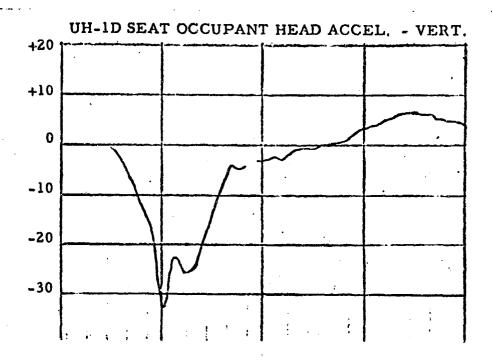


Figure B8. UH-1B/D SEAT TEST NO. 3.





TIME (SECONDS)
Figure B9. UH-1B/D SEAT TEST NO. 3.



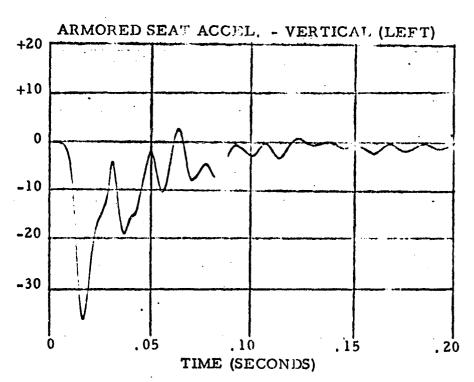
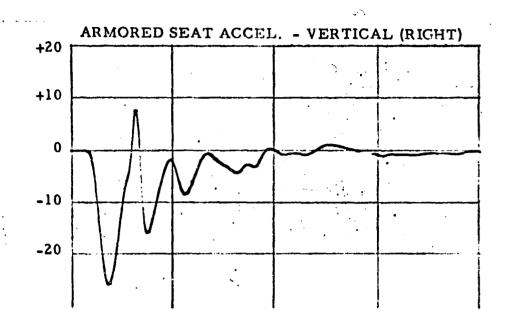


Figure Blog UH-1B/D SEAT TEST NO. 3.



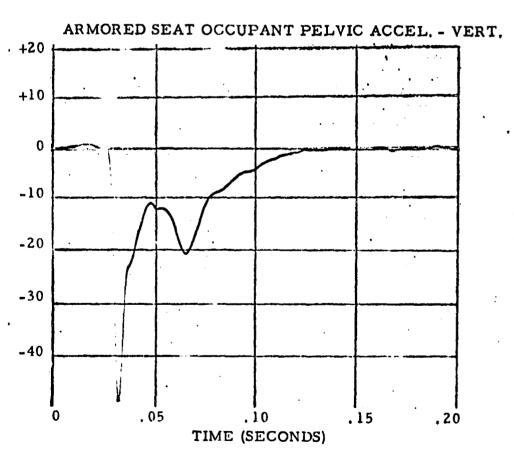


Figure B11. UH-1B/D SEAT TEST NO. 3.

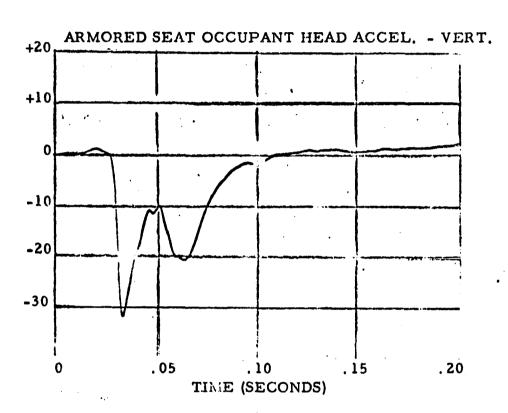


Figure B12. UH-1B/D SEAT TEST NO. 3.

14.	KEY WORDS		LINK A		LINK B		LINK C	
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